Fall 9-1-2008

C&I 404.01: Teaching Science K-8

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University of Montana
C & I 404: Teaching Science K-8
Fall 2008

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Office Hours:	As posted or by appt.	**Class Hours**:	M/W: 9:40-11:00; 12:40-2:00

Take Chances! Make Mistakes! Get Messy! – Ms. Frizzle

Required Readings:

- Membership in the National Science Teachers Association. Membership includes a subscription to Science and Children, Science Scope or Science Teacher and online access to all journal archives – a veritable feast of science teaching ideas. Visit http://www.nsta.org/ to register.

- Vasquez, J. (2008). Tools and traits for highly effective science teaching, K-8. Heinemann: Portsmouth, NH.

- Keeley, Eberle, & Tugel (2005). Uncovering student ideas in science. NSTA Press: Arlington, VA.

- Salish Kootenai Tribal History Project (2008). Challenge to survive: History of the Salish tribes of the Flathead Indian Reservation. Pablo, MT: Salish Kootenai College Press.

- One Engineering Is Elementary Teaching Guide of your team's choice: 1) Catching the Wind: Designing Windmills; 2) To Get to the Other Side: Designing Bridges; 3) Water, Water Everywhere: Designing Water Filters; 4) A Sticky Situation: Designing Walls; 5) The Best of Bugs: Designing Hand Pollinators; 6) An Alarming Idea: Designing Alarm Circuits; 7) Sounds Like Fun: Seeing Animal Sounds; 8) Marvelous Machines: Making Work Easier; 9) Just Passing Through: Designing Model Membranes; 10) The Attraction is Obvious: Designing Maglev Systems; 11) A Work in Progress: Improving a Play Dough Process; 12) A Stick in the Mud: Evaluating a Landscape; 13) Thinking Inside the Box: Designing Plant Packages. Order from the Boston Science of Museum: http://www.eiestore.com/cuma.html.

- National Science Education Content Standards: http://teachingscience.wikispaces.com/Standards+Links

- Teaching Science K-8 Wikispace: http://teachingscience.wikispaces.com/

Course Description

Welcome to Methods of Teaching Elementary Science! How do K-8 students construct science understandings? Which classroom conditions foster opportunities for students to learn and enjoy science? What teaching strategies engage students in doing and understanding science? What does it mean to be a culturally responsive teacher? These questions will be the guiding framework for this course. You will explore these questions by reflecting on your own and others' science learning and teaching, and through reading and discussing research about science teaching and learning. We will pay particular attention to the inquiry approach modeled by the National Science Education Standards. Class experiences are designed to help you be able to:

1. Present and defend your beliefs about elementary science teaching and learning;

2. Articulate the essential elements of a scientific worldview and recognize science as one way to systematically understand the natural world;
3. Identify the essential elements of an indigenous worldview, gain confidence in identifying the characteristics of culturally responsive curriculum, and become aware of culturally integrated science resources, particularly those that develop a deeper understanding of Montana's Indian nations.
4. Explain how students' science ideas and cultural context influence learning and become proficient in using questioning strategies and assessment probes to reveal students' science understandings;
5. Differentiate between elementary science experiences that teach both content and inquiry from those that do not;
6. Use teaching strategies that facilitate student interest and learning in science and are consistent with an inquiry teaching/learning model;
7. Plan culturally integrated learning opportunities which integrate science across the curriculum using a model of conceptual change teaching;
8. Develop students' critical reading and writing skills using science notebooks;
9. Become aware of the Science, Technology, Engineering, and Math (STEM) reform agenda and proficient in implementing STEM best practices in the classroom;
10. Apply research to the selection, comparison, and implementation of elementary science curriculum;
11. Understand ways to assess student learning in science and gain proficiency in using a variety of technologies to provide multiple means for students to demonstrate learning; and,
12. Reflect upon your science teaching, noting areas of mastery and areas of emerging growth.

Expectations

This is a course in which all students will be active participants. You must be more than physically present—you must make positive contributions to the ongoing learning of others. Students are responsible for class preparation and discussions during the class period. Preparing for class will involve reading the assigned materials, as well as identifying and reading additional resources. Regular attendance is expected. Due to the nature of the course, attendance, participation, and discussion are crucial components in achieving the course objectives. Absentees are responsible for any in-class announcements, changes in the syllabus, and material discussed in class.

Assignments are due in class on the dates listed. Late assignments will not be accepted unless prior arrangements have been made with the instructor. Assignments will be graded using criterion-referenced methods, i.e., a specific set of standards. As a general guide, a "C" grade represents average work. It means that all assignments are done as described. A "B" grade represents above average work. It indicates that self-initiative has been taken to research topics and bring more to the assignment than just required. An "A" grade represents a high level of mastery with evidence of reflection and research as well as personal innovation, relevant applications, and extensions. **Should you have any questions concerning a grade, I am always happy to discuss them but ask that you make an appointment so I can give the matter careful consideration and maintain confidentiality.**

It is important to remember that effort alone does not necessarily guarantee above average grades; rather, high quality thought and products ensure above average grades. To meet professional presentation standards required of practicing teachers, **your assignments must be word-processed, succinctly written, fully referenced, and stapled.**

A final note, I know the block schedule is tight, so eating in class is hard to avoid. If you bring food and drink with you, please be sure to dispose of it appropriately. **Also, because this is a large group in such a small space, please remember to show respect for your fellow classmates. Outside conversations, newspapers in class, cell phones, and tardiness are a real distraction to other students.**

Sequence of Topics & Evaluation

Part I: **Topics:** The nature of science, indigenous knowledge systems; science standards, inquiry, process skills, fair test
Assessment: Science is Everywhere Photoessay; Formative Assessment Probe; Standards Paper; Science Study Group

Part II: **Topics:** Students' science ideas, teaching for conceptual understanding, 5E's, science notebooks; assessment
Assessment: Science Lesson & Concept Analysis (using wikispaces); Science Study Group

Part III: **Topics:** Integrating science; STEM curricula; culturally responsive science curricula; science olympiad;
Assessment: Salish Plant & Animal Google Earth tour; Engineering is Elementary; Integrated Unit; GPS; Science Study Group

Course Assignments

Participation/In-class Activities: This is due daily or as announced. Your attendance and participation are highly valued. I will take roll each class session and give one point for each full class attended.

Science Study Group Sessions: Each student or study group of no more than three students will complete two science study group sessions. The science study group sessions will be related to course readings or explorations as a tool for reflection and synthesis. Details for completion of the study group sessions will be provided in class. **Science Study Group One due 10/3; Science Study Group Two due 11/12.**

Science is Everywhere PhotoEssay: How do you launch a science classroom rich in inquiry opportunities? First, students need to learn how to ask a testable question. You and a partner will develop and share a five slide powerpoint which includes five images and at least ten testable questions. The slideshow should represent a complete science content domain (Biology, Physical Science and Earth/ Space Science) and include images from, the community and/or issues in the local and national news. **Due 8/27.**

Using Formative Assessment Probes: Summative assessment dominates today's educational landscape. In this assignment, you will work with a team to present a 15 minute assessment probe that can be used either as a formative or a summative assessment. **Due 9/15.**

Standards Paper: Schools across the nation are reviewing their curriculum to ensure that it aligns with the *National Science Education Standards*. It is important for you to understand what the standards define as best practice and be able to identify non-example and example best-practice science lessons. In this paper, you will identify and print one best-practice science lesson (this lesson must come from one of the following sources: Science Scope or Science and Children; the journal must be dated 1996 or later) and one science lesson that does not model best science practices (this may come from textbooks, curriculum modules, internet, etc.). Your discussion section will provide evidence from the research for your choices, discuss where the lesson is aligned with the NSES content standards, and provide adaptations for the non-example to align it with the standards. **Due 9/24.**

Science Lesson & Concept Analysis: "Let's do it again!" Those four words are a strong indication that your students are engaged. Mastery of facilitating meaningful science learning opportunities for your students can best be measured by performance. This assignment will have several parts, each designed to familiarize you with the components of a science lesson based on teaching for conceptual understanding.

For your first step, you and your partner will identify your science topic area and science concept to be taught. Your cooperating teacher will help you with the concept selection. After selecting your science concept to be taught, you will need to learn as much as you can about the concept. The second part of the assignment will be to develop a 5 E's science lesson plan to teach to elementary students as part of your field

experience. A detailed lesson plan format will be provided in class. A draft lesson plan will be developed and reviewed with your instructor during **a 20 minute private conference that your team schedules with me during week six**. The draft should be as complete as possible.

Effective science teaching requires that students first be made aware of their existing science ideas. As part of your science lesson you teach in the field, you and your partner will develop a strategy to reveal students' pre-existing science ideas. This may be a student drawing, concept map, prediction sheet, etc. You will ask students to revisit these at the end of your lesson and reflect on their current science understandings. **Your science lesson must be taught during week seven**. **Your lesson plan will be shared with your classmates using wikispaces during week seven.**

In the third part of this assignment, you and your partner will complete a teaching analysis of the science lesson. In your analysis you will report on your assessment of the students' understanding of the science concept based on the data you collected when revealing students' science ideas. A detailed outline of analysis expectations will be provided in class. **The concept analysis is due week eight.**

Integrating Essential Understandings into your Science Program: Salish Plant & Animal Google Earth Tour: One of the many challenges with the Indian Education for All legislation is how to develop curricula and pedagogical frameworks that appropriately incorporate tribal knowledge, diversity, and ways of knowing into a formal educational system that was founded on Western principles of education. In this assignment you will explore the PlaceNames Project. The PlaceNames Project advocates the use of a "critical pedagogy of place" to help schools integrate tribal understandings into their teaching communities. Imbedded in a critical understanding of place is a commitment to culturally responsive teaching - to redress the legacy of colonization and to learn how to live well together in a place. This requires that students be conscious not only of their place, but that of others' places, and the relationship of these places to their identity and others' sense of being.

How well do you know your place? Having a sense of place means far more than what makes a location special or unique; rather, it is an abiding connection to place so deep that it defines who one is, how one thinks (habits of mind) and how one lives in a given landscape. The land, its patterns, and the plants and animals become the teacher, bonding a people to a place, shaping habits of mind and worldviews.

In this assignment you will create a Google Earth tour of one of the plant or animal life cycles significant to the Salish and Pend d'Oreille people. A detailed course outline will be provided in class. **Due 10/22**

Engineering is Elementary: The *Engineering is Elementary* (EiE) project aims to foster engineering and technological literacy among children. EiE has created a research-based, standards-based, and classroom-tested curriculum that integrates engineering and technology concepts and skills with elementary science topics (STEM). EiE materials also connect with literacy, social studies, and mathematics. Through interesting engineering design challenges children are invited to apply their knowledge of science, engineering, and their problem solving skills, as they design, create, and improve possible solutions. For this assignment you will teach an EIE lesson to your peers from an EiE teacher guide and storybook of your choice. **You will teach this lesson with a group of three other students who will be teaching *different lessons from the same EiE teaching guide* on 11/3 or 11/5.**

Integrated Unit Plan. When you begin classroom science teaching, a primary task you will face is developing curriculum in the form of units. For this course assignment, you will work with a partner to design and implement a series of lessons at a local elementary school. This assignment is an integral part of your field experience and is described in depth in your field experience seminar. **Your integrated unit must include at least one science notebook or an integrated science lesson plan using the 5 E's format. Due 12/5.**

GPS: Geotechnologies integrate science, social studies, math, technology and literacy. One example of a geotechnology is a GPS unit (think: your car if you can afford a new one). This GPS exploration will be **completed in class on 12/3.** A detailed assignment outline will be provided in class.

Accommodations

Please contact me following the first class meeting to arrange any teaching/learning accommodations you require.

Graduate Students

All graduate students must complete a graduate increment for this course. As an individual or in a team, research an area of science education that you believe is important to effective science teaching (It may be helpful to refer to the 2007 Handbook of Research on Science Education. Develop a 20 minute powerpoint that will be presented during the final exam time listed in the course syllabus. Your powerpoint will be evaluated using the criteria outlined below:

- Clear introduction to the topic is present. The topic is selected from an area of science education research that clearly supports or informs effective science teaching. A rational for topic selection is delineated.
- Well-organized progression of information is provided with research from the following refereed science education journals: Science Education and Journal of Research in Science Teaching and one other refereed journal of your choice.
- Plan for three talking points within the presentation where dialogue and discussion with the class is encouraged, present, and effective.
- Connections to central issues framing the teaching of elementary science are identified.
- Three recommendations for teaching science are provided. These recommendations are thoughtful, reasonable, and research based.
- Annotated bibliography of resources is included and contains at least five citations.

Academic Misconduct

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/SA/VPSA/index.cfm/page/1321.

Dynamic Course Schedule

Week 1

8/25 THE NATURE OF SCIENCE: What is science and why teach it?
Reading: Science for All American Online, Chapter 1: The Nature of Science.
http://www.project2061.org/publications/sfaa/online/chap1.htm

8/27 THE NATURE OF SCIENCE: How do students learn to ask testable questions?
Reading: Young, L., Taggart, G., Adams, P., & Costigan-Talbott, N. (September, 2006). *Using testable questions to teach motion and forces.* Science Scope.
Due: Science is Everywhere PhotoEssay

Week 2

9/1 NO CLASS – Labor Day Holiday

9/3 INDIGENOUS KNOWLEDGE SYSTEMS: How do I help students navigate the intersection of diverse worldviews? What does it mean to be a culturally responsive science teacher?
Reading: Indigenous Knowledge Systems/Alaska Native Ways of Knowing
http://www.ankn.uaf.edu/Curriculum/Articles/BarnhardtKawagley/Indigenous_Knowledge.html

Week 3

9/8 SCIENCE STANDARDS: How do I know what/how to teach?
Reading: 1) National Science Education Standards, Chapter Six and Montana Content Standards for Science: http://teachingscience.wikispaces.com/Standards+Links#1

9/10 SCIENCE STANDARDS AND INQUIRY: Defining inquiry and process skills (Inquiry ≠ hands-on)
Reading: Weinburg, M. (July/August 2004). *Teaching photosynthesis.* Science Scope.

Week 4

9/15 USING FORMATIVE ASSESSMENT PROBES: How do you reveal students' ideas about science?
Reading: Keeley, Eberle, & Tugel (2005). Uncovering student ideas in science: 25 Formative Assessment Probes. NSTA Press: Arlington, VA. (Volume I or II).
Due: Assessment Probe

9/17 CHILDREN'S SCIENCE IDEAS: How do children's science ideas influence learning? The Private Universe. (http://www.learner.org/teacherslab/pup/index.html)
Reading: Kang, Nam-Hwa & Howren, C. (September, 2004). *Teaching for conceptual change.* Science and Children.

Week 5

9/22 TEACHING FOR CONCEPTUAL UNDERSTANDING: How do I plan and write a lesson plan using the 5 E's strategy?
Reading: Everett, S. & Moyer, R. (March, 2007). *Inquirize your teaching: A guide to turning favorite activities into inquiry lessons.* Science and Children.

9/24 TEACHING CONTROVERSIAL ISSUES IN SCIENCE:
Reading: Science, evolution, and creationism, National Academy of Sciences:
http://teachingscience.wikispaces.com/Teaching+Controversial+Issues+in+Science
Due: Standards Paper

Week 6

9/29 **LESSON CONFERENCES**

10/3 **LESSON CONFERENCES**
Due: Science Study Group One

Week 7

10/6 **TEACHING MATH, SCIENCE, & SOCIAL STUDIES LESSONS IN THE SCHOOLS!!**

10/8 **Lessons in the schools cont'd**.

Week 8

10/13 CULTURALLY RESPONSIVE SCIENCE CURRICULUM: What is it and how can I use it to support Native knowledge systems?
Readings: PlaceNames Project
http://www.spatialsci.com/PlaceNames/

10/15 CULTURALLY RESPONSIVE SCIENCE CURRICULUM: Using a place-based multicultural pedagogy.
Reading: Challenge to survive, Unit I: From Time Immemorial, Traditional Life, Section A: Economic Activities
Due: Lesson Plan and Concept Analysis

Week 9

10/20 SCIENCE NOTEBOOKS: Integrating science into your literacy program.
Reading: Nesbit, C., Hargrove, T., Harrelson, L., & Maxey, B. (Winter, 2004). 1) *Implementing Science Notebooks in the Primary Grades*, Vol.40 (4): 21-29; 2) Science notebooks in K12 Classrooms http://www.sciencenotebooks.org/

10/22 SCIENCE ASSESSMENT: How do you assess students' ability to do inquiry? To understand and apply science concepts?
Reading: 1) Peter, E. (January, 2008). *Assessing scientific inquiry*. Science Scope. 2)NAEP: http://nces.ed.gov/nationsreportcard/science/
Due: Google Earth tour

Week 10

10/27 STEM CURRICULUM REFORM MOVEMENT AND SCIENCE OLYMPIAD: What is STEM, why should I care, and how is the Science Olympiad one way to implement STEM?
Reading: Innovation American: Building a Science, Technology, Engineering and Math Agenda http://www.nga.org/Files/pdf/0702INNOVATIONSTEM.PDF

10/29 STEM CURRICULUM CONT'D: How do I create engineering and design opportunities for my students? Getting to know the WORLD IN MOTION SAE curriculum.
Reading: *A World in Motion JetToy Manual.*

Week 11

11/3 ENGINEERING IS ELEMENTARY: Engineering isn't just for physical science?
Due: Engineering is Elementary Lesson Study

11/5 ENGINEERING IS ELEMENTARY, cont'd
Due: Engineering is Elementary Lesson Study

Week 12

11/10 TRADITIONAL SALISH TECNOLOGIES: A visit from Tim Ryan, Ancestral Skills and Technologies: Exploring traditional Salish tool making and use.

11/12 **INTEGRATED UNIT WORK SESSION**
Due: Science Study Group Two

Week 13

11/17 **INTEGRATED UNIT TEACHING!**

11/19 **INTEGRATED UNIT TEACHING!**

Week 14

11/24 **INTEGRATED UNIT TEACHING!**

11/26 **NO CLASS: Thanksgiving Holiday**

Week 15

12/1 GEOSPATIAL TECHNOLOGY: Examining contemporary tribal use of technologies for resource management.

12/3 GEOSPATIAL TECHNOLOGY cont'd
Due: GPS (completed in class)

Week 16

Final Exam Meeting Times: Section One: Wednesday, December 10, 8:00-10:00
Section Two: Monday, December 8, 8:00-10:00

Grading Policy

Final grades will be calculated based on the following percentages of total points:

A	95-100
A-	92-94
B+	90-91
B	87-89
B-	84-86
C+	81-83
C	78-80
C-	76-77
D	68-75
F	Below 68

Assignment	Value
Participation	5%
Science Study Group	15%
PhotoEssay	5%
Formative Assessment Probe	5%
Standards Paper	15%
Science Lesson/Concept Analysis	15%
Salish Google Earth Tour	10%
Engineering is Elementary	10%
Integrated Unit	15%
GPS	5%

Please note that this document serves as a guide for course content and student evaluation. I welcome student input and reserve the right to be a learner as well as a facilitator. Thus, I may adjust this guide as the semester proceeds. Any changes will be announced in class.